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Hybrid Rydberg atom-photon-superconductor quantum interface

J.D. PRITCHARD, J.A. ISAACS, M.A. BECK, R. MCDERMOTT, M. SAFFMAN, Department of Physics, University of Wisconsin, 1150 University Avenue, Madison, Wisconsin 53706 — Hybrid quantum computation exploits the unique strengths of disparate quantum technologies, enabling realization of a scalable quantum device capable of both fast gates and long coherence times. We propose a quantum interface for creating hybrid entanglement between neutral atom and superconducting qubits. The interface is mediated by coupling superconducting qubits to microwave photons, and microwaves to Rydberg excited single atoms using chip-based coplanar waveguide microwave cavities. We have developed a simple gate scheme to enable entanglement of an atomic qubit with a microwave photon, with fidelity calculations based on realistic parameters giving Bell-state preparation fidelity exceeding 0.999 on μs timescales [1]. Experimental progress towards the coherent excitation of a single atom above a coplanar waveguide in a 4 K cryostat will be presented.

[1] J. D. Pritchard, J. A. Isaacs, M. A. Beck, R. McDermott and M. Saffman, *Hybrid atom-photon quantum gate in a superconducting microwave resonator*, Phys. Rev. A **89**, 010301(R) (2014)

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